SEQUENCE OF OPERATION

GENERAL:

1. ALL CONTROLS SYSTEMS SHALL BE COMPLETE AND OPERATIONAL AT THE CONCLUSION OF THE CONSTRUCTION PROJECT.
2. IN A VISIBLE LOCATION ON HVAC EQUIPMENT UNDER DIRECT DIGITAL CONTROLLER (DDC) CONTROL, MOUNT A LAMINATED PLATE INSCRIBED WITH THE FOLLOWING: "CAUTION: THIS EQUIPMENT IS UNDER CENTRAL CONTROL AND MAY START OR STOP SUDDENLY. CONTACT PUBLIC WORKS BEFORE PERFORMING ANY MAINTENANCE OR DISCONNECTING ANY COMPONENTS."
3. DDC CONTROLLERS SHALL UTILIZE SHORT CYCLING DELAYS TO PROTECT NONMODULATING TYPE EQUIPMENT SUCH AS FANS, PUMPS, COMPRESSORS, ETC. FROM SHORT CYCLING.
4. TERMINAL CONTROL UNITS (TCUs) SHALL BE STAND-ALONE PROGRAMMABLE AND SHALL BE SELECTED WITH THE APPROPRIATE NUMBER OF INPUTS AND OUTPUTS AS REQUIRED BY THE UNITS SEQUENCE OF OPERATION AND THE I/O SCHEDULE.
5. ALL CONTROL AND INTERLOCK WIRING SHALL BE SUPPLIED AND INSTALLED IN ACCORDANCE WITH THE SUPPLIED UNITS MANUFACTURERS RECOMMENDATIONS.

VAV BOXES

GENERAL:

1. THE VAV BOX DAMPER SHALL BE CONTROLLED BY ITS TERMINAL CONTROL UNIT (TCU) BASED ON A TIMED OCCUPANCY AS SCHEDULED FOR THE AIR HANDLING UNIT WHICH IT SERVES.
2. A WALL MOUNTED SPACE SENSOR SHALL CONTROL ROOM CONDITIONS THROUGH THE TCU AND ENABLE THE ROOM OCCUPANTS TO VARY THE SPACE SETPOINT OVER A LIMITED RANGE AS DETERMINED BY THE DDC.
3. THE SPACE SENSOR SHALL DISPLAY TEMPERATURE SETPOINT AND SPACE TEMPERATURE.
4. THE SPACE SENSOR SHALL PROVIDE A TIMED OVERRIDE SCHEDULE THROUGH AN ON/OFF BUTTON.

OCCUPIED MODE:

1. IN THE COOLING MODE THE TCU SHALL MODULATE THE VAV BOX SUPPLY AIR DAMPER TO MAINTAIN THE SPACE SETPOINT OF 75°F (ADJUSTABLE). ON A DROP IN SPACE TEMPERATURE, THE TCU SALL MODULATE THE VAV BOX DAMPER TO ITS MINIMUM POSITION.
2. IN THE HEATING MODE THE TCU SHALL SHALL ACTIVATE THE HOT WATER SYSTEM THROUGH THE DDC TO MAINTAIN THE SPACE SETPOINT OF 70°F (ADJUSTABLE). ON A DROP IN SPACE TEMPERATURE,

ERV

OCCUPIED MODE:

1. OPERATION OF THE ERV SHALL BE CONTROLLED BY THE DDC SYSTEM. THE UNIT SHALL RUN WHENEVER THE AHU IS ON.

UNOCCUPIED MODE:

2. OPERATION SHALL BE CONTROLLED BY THE DDC SYSTEM. DURING THE UNOCCUPIED MODE THE UNIT SHALL BE OFF AND THE OUTSIDE AIR DAMPER SHALL BE CLOSED.

MORNING WARM-UP/COOL DOWN:

3. OPERATION SHALL BE CONTROLLED BY THE DDC SYSTEM. DURING THE WARM-UP/COOL DOWN PERIOD THE UNIT SHALL BE OFF AND OA DAMPER SHALL BE CLOSED.

OVERRIDE MODE:

4. OPERATION SHALL BE CONTROLLED BY THE DDC SYSTEM WHEN ANY AHU IS ENERGIZED DURING OVERRIDE PERIOD THE UNIT SHALL RUN AND SHALL BE DE-ENERGIZED WHEN OVERRIDE PERIOD IS CONCLUDED.

AHU-1, AHU-2

1. GENERAL

1.1 UNIT IS NORMALLY STARTED AND STOPPED REMOTELY AT THE ECC. H-O-A SWITCH SHALL BE KEPT IN THE "AUTO" POSITION. "HAND" AND "OFF" POSITIONS SHALL BE USED ONLY FOR MAINTENANCE. WHEN THE UNIT IS "OFF" D-1, D-3, SHALL BE FULLY CLOSED. WHEN THE UNIT IS "ON" D-1, SD-1 AND SD-2 SHALL BE FULLY OPEN. D-2 AND D-3 SHALL MODULATE IN ACCORDANCE WITH THE FOLLOWING SEQUENCE. DURING OCCUPIED MODE ERV, EXHAUST FAN, AND OUTSIDE AIR FAN SHALL MODULATE IN ACCORDANCE WITH THE FOLLOWING SCHEDULE.

2. TEMPERATURE CONTROL

2.1 SUPPLY AIR TEMPERATURE, SENSED BY TT-1, SHALL BE MAINTAINED AT SETPOINT VIA DIGITAL CONTROL PANEL BY MODULATING V-1 OR D-2 AND D-3 IN SEQUENCE.

2.2 WHEN THE TEMPERATURE OF THE OUTSIDE AIR, SENSED BY TT-2, IS ABOVE 75°F (ADJ) [23.8°C], THE DIGITAL CONTROL PANEL SHALL PREVENT THE MODULATION OF D-2 AND D-3 AND SHALL ASSUME THE ERV MINIMUM OUTSIDE AIR SPEED AND FULLY OPEN D-1, D-4, AND D-2+3. THE DIGITAL CONTROL PANEL SHALL MODULATE V-1 TO MAINTAIN THE SUPPLY AIR TEMPERATURE, SENSED BY TT-1.

2.3 WHEN THE TEMPERATURE OF THE OUTSIDE AIR, SENSED BY TT-2, IS BETWEEN 65°F [18.3°C] AND THE SUPPLY AIR TEMPERATURE SENSED BY TT-1, DAMPER D-2 SHALL FULLY CLOSE AND D1 AND D4 SHALL BE FULLY OPEN (MAXIMUM OUTSIDE AIR POSITION). THE DIGITAL CONTROL PANEL SHALL MODULATE V-1 TO MAINTAIN THE SUPPLY AIR TEMPERATURE, SENSED BY TT-1.

2.4 WHEN THE TEMPERATURE OF THE OUTSIDE AIR, SENSED BY TT-2, IS BELOW THE SUPPLY AIR TEMPERATURE, SENSED BY TT-1, DAMPERS D1, D-2 AND D-3 SHALL MODULATE TO MAINTAIN THE SCHEDULED SUPPLY AIR TEMPERATURE. ERV SHALL OPERATE AT FULL SPEED. IF D-2 IS OPEN AND D-3 IS CLOSED TO MINIMUM OUTSIDE AIR, V-2 SHALL MODULATE OPEN TO MAINTAIN THE SUPPLY AIR TEMPERATURE, SENSED BY TT-1. IF OUTSIDE AIR DEW POINT IS BELOW 60°F, VALVE V-1 SHALL MODULATE TO LOWER DEWPOINT AS SENSED BY TT-1

3. AIR FLOW CONTROL

3.1 THE SUPPLY AIR FLOW SHALL BE CONTROLLED BY THE DIGITAL CONTROL PANEL MODULATING THE SUPPLY FAN VARIABLE SPEED MOTOR CONTROLLER TO MAINTAIN 1.0" [25mm] OF DUCT STATIC PRESSURE (FIELD ADJUSTABLE), SENSED BY SPS-1. RESET STATIC PRESSURE BASED ON ACTUAL BUILDING LOAD BY POLLING ALL ATU

3.2 THE DIGITAL CONTROL PANEL, USING TOTAL SUPPLY AIR AND RETURN AIR FLOW SIGNALS, SHALL MODULATE ERV, OSA, AND EXHAUST FANS TO MAINTAIN A CONSTANT AIR FLOW DIFFERENCE BETWEEN THE SUPPLY AIR AND THE RETURN AIR EQUAL TO MINIMUM OUTSIDE AIR.

3.3 USING HIGH PRESSURE SENSOR SPS-2 LOCATED AT THE SUPPLY FAN DISCHARGE, SHALL PREVENT THE SUPPLY FAN FROM DEVELOPING OVER 2.5" [75mm] OF STATIC PRESSURE (FIELD ADJUSTABLE). IF STATIC PRESSURE AT SPS-2 DOES EXCEED 3" [75mm] THE SUPPLY AIR FAN SHALL STOP. SPS-2 SHALL BE HARDWIRED TO THE SUPPLY FAN VSMC AND UNIT SHALL BE SHUTDOWN IN HAND,AUTO OR BYPASS MODE. SPS-2 WILL REQUIRE MANUAL RESET AT THE DEVICE.

4. DEHUMIDIFICATION CONTROL

4.1 IF RETURN AIR HUMIDITY SENSOR H-1 SENSES HUMIDITY GREATER THAN 60% (ADJUSTABLE), V-1 SHALL OPEN FULLY AND VAV HEATING COIL BOXES SHALL MODULATE TO MAINTAIN ROOM TEMPERATURE. V-1 SHALL MODULATE NORMALLY WHEN RETURN AIR HUMIDITY LEVELS RETURN TO LEVELS BELOW 55%.

4.2 RETURN AIR HUMIDITY SHALL BE MAINTAINED AT SETPOINT OF 35% RH (ADJ) VIA DIGITAL CONTROL PANEL BY MODULATING CONTROL VALVE V-4 TO MAINTAIN THE DESIRED HUMIDITY. THE DCP SHALL OVERRIDE THIS CONTROL TO MAINTAIN HUMIDITY OF 80% AS SENSED BY H-2. DCP SHALL CLOSE VALVE V-3 WHENEVER THE SUPPLY FAN IS OFF. VALVE V-4 SHALL BE INTERLOCKED WITH A TEMPERATURE SWITCH TO KEEP THE HUMIDIFIER OFF UNTIL CONDENSATE TEMPERATURE APPROACHES STEAM TEMPERATURE.

5. FREEZE PROTECTION

5.1 IF THE AIR TEMPERATURE AS SENSED BY TT-3 FALLS BELOW 45°F [7°C], AN ALARM SIGNAL SHALL INDICATE AT THE DCP AND ECC. IF THIS TEMPERATURE FALLS BELOW 40°F [4.4°C], AS SENSED BY THE TSL THE SUPPLY AND RETURN FANS SHALL SHUT DOWN AND A CRITICAL ALARM SHALL INDICATE AT THE DIGITAL CONTROL PANEL AND ECC. TSL SHALL BE HARDWIRED TO THE SUPPLY FAN UFD AND UNIT SHALL BE SHUTDOWN IN HAND,AUTO OR BYPASS MODE. TSL WILL REQUIRE MANUAL RESET AT THE DEVICE.

6. AUTOMATIC SHUTDOWN/RESTART

6.1 WHEN SMOKE IS DETECTED BY DUCT SMOKE DETECTOR, SD, THE SUPPLY AND RETURN FANS SHALL SHUT "OFF" AND AN ALARM SIGNAL SHALL BE TRANSMITTED TO THE FIRE ALARM SYSTEM. ALL SMOKE DAMPERS IN THE SUPPLY AND RETURN DUCTS SHALL CLOSE.

6.2 EXHAUST FANS SERVING AREA OF THE SUPPLY FAN SHALL CONTINUE TO RUN. SUPPLY AND RETURN FANS SHALL RESTART AND SMOKE DAMPERS SHALL OPEN WHEN FIRE ALARM CIRCUIT IS RESET.

7. EMERGENCY CONSTANT SPEED OPERATION

7.1 UPON FAILURE OF THE VSMC, THE SUPPLY AND RETURN FANS AND ERV EXHAUST AND OSA FANS SHALL BE STARTED/STOPPED MANUALLY AT THE DIGITAL CONTROL PANEL OR THE ECC THROUGH THE BY-PASS STARTER. FANS SHALL THEN BE OPERATED AT CONSTANT SPEED.

8. UNOCCUPIED SCHEDULE

8.1 DURING UNOCCUPIED SCHEDULE, ERV SHALL BE OF, AHU SHALL BE OFF, D1 AND D-4 SHALL BE CLOSED. IF TEMPERATURES GO BEYOND UNOCCUPIED SETBACK TEMPERATURES, AHU, FAN, V-1 OR VAV HEATING VALVE SHALL MODULATE TO MAINTAIN TEMPERATURES, AND RETURN TO OFF AFTER A TIME OF 30 MINUTES (ADJUSTABLE).

COOLING TOWER (CT1)

GENERAL:

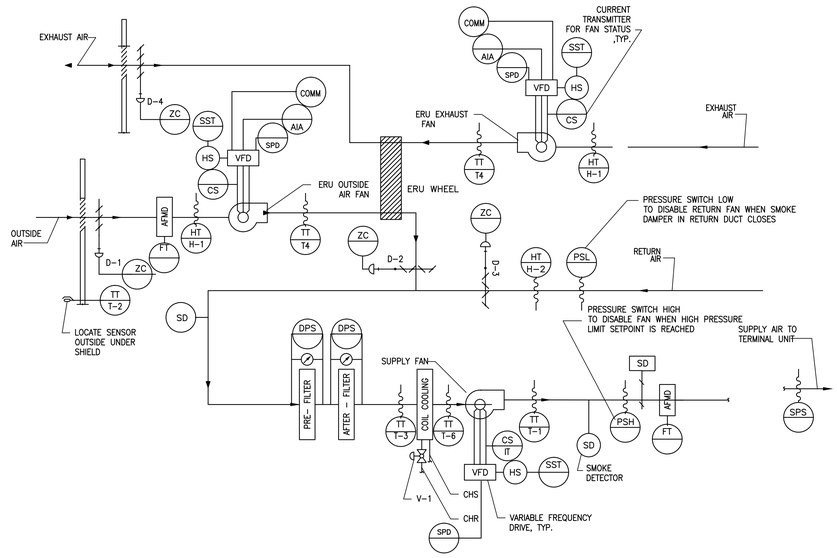
1. A COOLING TOWER STAND ALONE CONTROLLER (SAC) SHALL CONTROL THE COOLING TOWER AS INDEXED BY THE DDC. THE CHILLER SAC SHALL BE PROVIDED BY THE COOLING TOWER MANUFACTURER WITH SOFTWARE FEATURES AND STRATEGIES AS DESCRIBED BELOW.
2. THE COOLING TOWER SAC SHALL PROVIDE ITS OWN INTERNALLY GENERATED STAGING COMMANDS.
3. THE COOLING TOWER SAC SHALL INTERFACE WITH THE DDC FOR MONITORING INPUTS AS LISTED IN THE I/O SUMMARY AND FOR REMOTE SETPOINT ADJUSTMENTS.

COOLING TOWER STAGING:

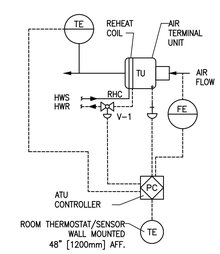
1. THE COOLING TOWER SAC SHALL PROVIDE INTERNALLY GENERATED STAGING COMMANDS TO MAINTAIN THE WATER SUPPLY TEMPERATURE SETPOINT AS DIRECTED BY THE DDC. THE COOLING TOWER SHALL NOT OPERATE UNTIL SYSTEM FLOW IS PROVEN.

HOT WATER SYSTEM

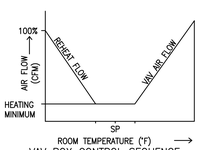
1. THE DDC SHALL CONTROL THE HEATING WSHP'S, HOT WATER TEMPERATURE AND THE HEATING SYSTEM PUMP.
2. PROVIDE HEATING SYSTEM PUMP WITH A HAND-OFF-AUTO SWITCH. IN THE "HAND" POSITION, THE PUMP SHALL BE CONTROLLED MANUALLY. IN THE "AUTO" POSITION, THE PUMP SHALL BE CONTROLLED BY THE DDC.
3. THE CONDENSER WATER BOILER SHALL BE STARTED AND STOPPED BY THE DDC WHEN CONDENSER WATER TEMPERATURE DROPS BELOW 40°F (ADJUSTABLE)



VARIABLE AIR VOLUME AIR HANDLING UNIT UNDER HVAC VA DETAILS CONTROL DIAGRAM

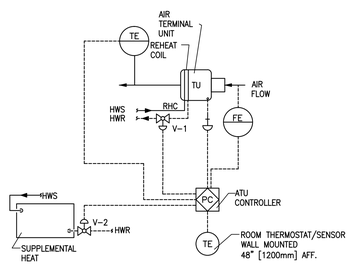


NO SUPPLEMENTAL HEATING

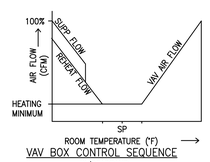


VAV BOX CONTROL SEQUENCE W/DEADBAND

A. SET POINTS SHALL BE SET AS FOLLOWS:
COOLING 75°F (ADJ)
HEATING 70°F(ADJ)
DEADBAND OF 5° F BETWEEN HEATING AND COOLING SET POINTS WILL BE MAINTAINED.
B. UPON FALL IN SPACE TEMPERATURE THE VAV DAMPER WILL MODULATE TO MINIMUM POSITION.
C. UPON FURTHER DROP IN SPACE TEMPERATURE VALVE V-1 WILL MODULATE TO MAINTAIN SET POINT ± .5° F. THE ADJUSTABLE TOLERANCE OF ± .5° F HAS BEEN SELECTED TO PREVENT VALVE HUNTING
D. THE REVERSE SHALL OCCUR ON THE RISE IN SPACE TEMPERATURE.



WITH SUPPLEMENTAL HEATING



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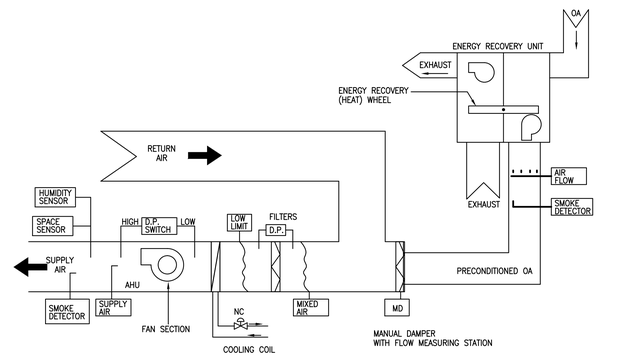
D. VALVE V-2 SHALL BE ENABLED WHEN OUTSIDE AIR FALLS BELOW 40° F (ADJ) AND VALVE V-1 HAS BEEN MODULATED OPEN ABOVE 30% (ADJ). VALVE V-2 SHALL MAINTAIN SET POINT ± .5° F. THE ADJUSTABLE TOLERANCE OF ± .5°F HAS BEEN SELECTED TO PREVENT VALVE HUNTING.
E. THE REVERSE SHALL OCCUR ON THE RISE IN SPACE TEMPERATURE.



TYPICAL AHU WITH ENERGY RECOVERY
(AH1/ERU1 & AH2/ER2)

FINAL SUBMISSION

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Approved: Project Director

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Location: PANAMA CITY, FLORIDA

Date: 16 APRIL 2012 | Checked: RL | Drawn: TF

Project Number: 520-326

Building Number: -

Drawing Number: MI001

Dwg. 11 of 13

Office of Construction and Facilities Management

Department of Veterans Affairs

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